DOCUMENT RESUME

ED 270 302 SE 046 594

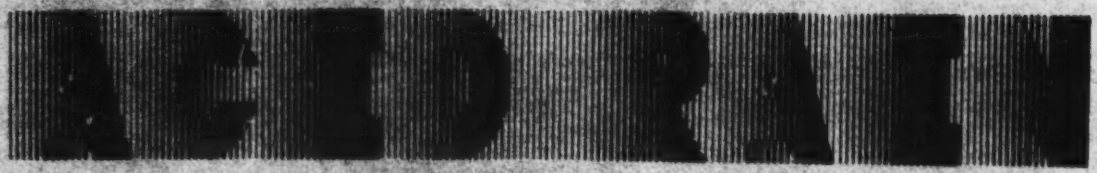
AUTHOR	Stubbs, Harriett S.; And Others
TITLE	Elementary Acid Rain Kit, Interdisciplinary, Grades 4-8.
INSTITUTION	Acid Rain Foundation, St. Paul, MN.
SPONS AGENCY	Minnesota State Dept. of Education, St. Paul.
PUB DATE	85
NOTE	68p.; For a related document, see SE 046 593.
AVAILABLE FROM	Acid Rain Foundation, Inc., 1630 Blackhawk Hills, St. Paul, MN 55122 ($35.00).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Art Education; *Elementary School Science; Elementary Secondary Education; *Environmental Education; *Interdisciplinary Approach; Junior High Schools; Language Arts; *Learning Activities; *Mathematics Education; Physical Environment; *Science Activities; Science Education; Science Materials; Social Studies
IDENTIFIERS	*Acid Rain

ABSTRACT

An interdisciplinary approach for teaching about acid rain is offered in this curriculum guide for teachers of grades 4-8. Skill and concept areas of science, math, social studies, art, and the language arts are developed in 12 activities which focus on the acid rain problems. A matrix of the activities and subject areas indicates the coverage patterns. Exercises include collage design, letterwriting, pH measurement, energy inventories, cartoon analysis, and neutralization experiments. Each activity consists of suggestions for: (1) time requirements; (2) educational objectives; (3) class organization; (4) needed materials (5) instructional procedures; and (6) additional activities. (ML)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED270302



THE ACID RAIN FOUNDATION, INC., 1630 Blackhawk Hills, St. Paul, MN 55122, 612/455-7719

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ELEMENTARY ACID RAIN KIT
Interdisciplinary, Grades 4-8

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY
Harriett S. Stubbs
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Developed by: Dr. Harriett S. Stubbs
Mary Lou Klinkhammer
Marsha Knittig

Administrative Support: Gayle Heuer

Editor: Karen Rhines

Technical Consultants: Dr. Eville Gorham, University of Minnesota
Dr. Ron Lorenz, Minnesota Department of Natural Resources
Mr. David Thornton, Minnesota Pollution Control Agency

Art, Layout & Design: Marsha Knittig
Dick Flor
Steve Pauley, Pauley Design

Evaluators:
Byron Bong
Myrna Boyken
Char Brooker
Pris Goelzer
Lance Johnson
Mary Lou Klinkhammer
Sister Lucy Knoll
Marcia Lawellin
Mary Leadenn
Bob Lindman
Charlotte Shover
Sister Eugenia Smith
Mary Sommers
Lynnanne Warren

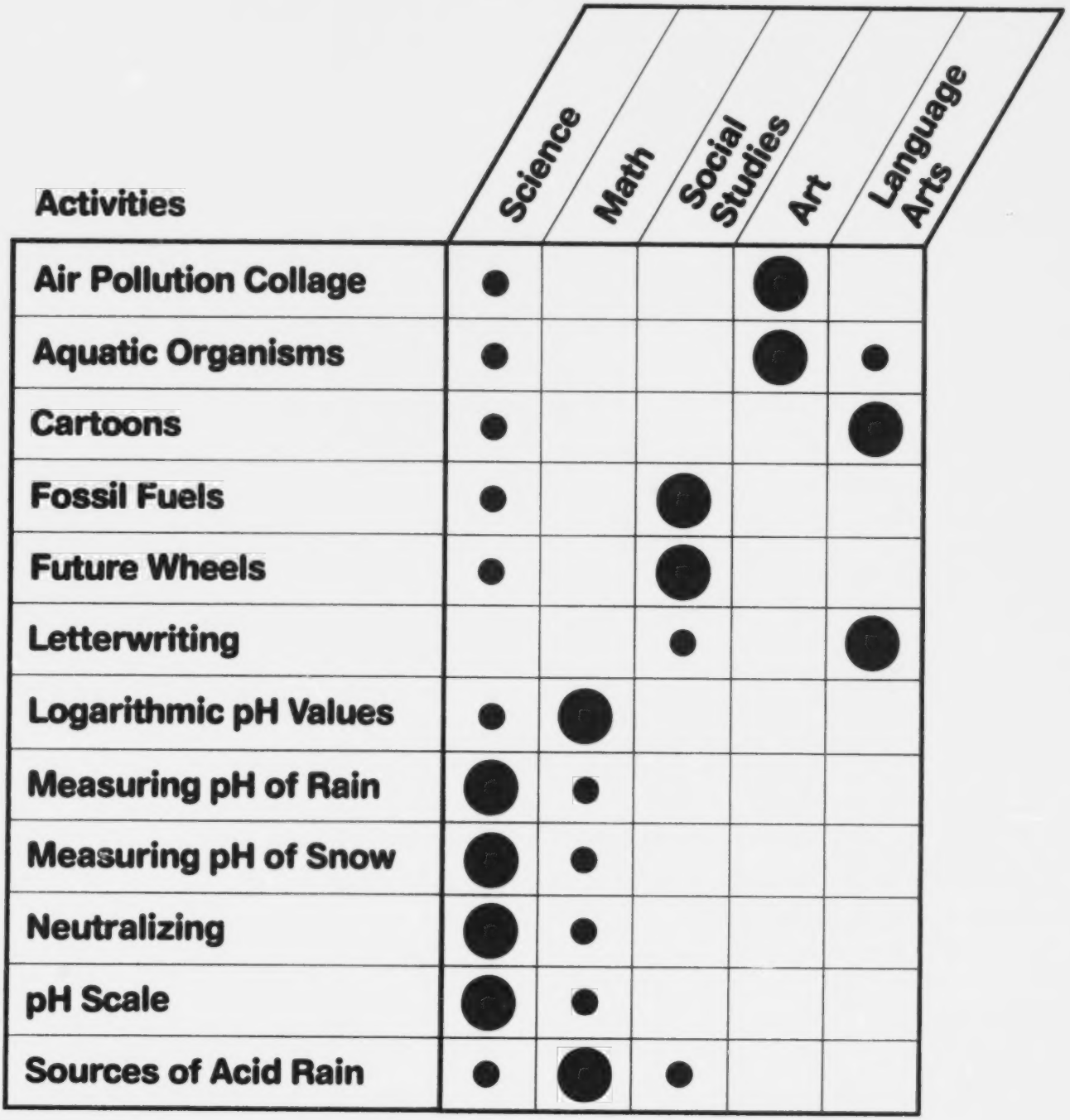
The development of the Elementary Acid Rain Curriculum was funded in part by:
Alida Rockefeller Dayton, Olivia Irvine Dodge, Minneapolis Womans Club, Minnesota Association of Outdoor Environmental Educators, The Bigelow Foundation, St. Paul Foundation, Mardag Foundation, Z. Smith Reynolds Foundation and the Freshwater Foundation

The publication of the Elementary Acid Rain Curriculum was contributed by:
Ecological Services Department of the Minnesota Department of Natural Resources

SE 046 594

Acid Rain Elementary Curriculum

(Grades 4-9)



©1985 **THE ACID RAIN FOUNDATION,** 1630 Blackhawk Hills, St. Paul, MN 55122

Elementary Acid Rain Education Evaluation

Date_____

Grade Level/Subject Area_____ School District_____

Name of Unit/Activity_____

Select one: My Personal Knowledge of Acid Rain Great____ Some____ None____

Select one: Used the Unit____ Used part of the Unit____ Did not use unit____

	EXCELLENT	GOOD	AVERAGE	POOR	VERY POOR
Importance of the Content					
Clarity of the Content					
Comprehensiveness of Content					
Accuracy of the Content					
Practicality of the Content					
Writing Style					
Organization					

LIKES	DISLIKES

COMMENTS AND SUGGESTIONS:

OPTIONAL: (If you would like to be added to our mailing list)

Name_____
Address_____ City_____ State____ Zip_____

Return to: THE ACID RAIN FOUNDATION, 1630 Blackhawk Hills, St. Paul, MN, 55122

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Art
Science

Air Pollution Collage

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

Several short time periods.

Objective

Objectives:

During this activity, students will:

1. Collect pictures illustrating air pollution and its sources
2. Create a collage with the collected pictures

The pollution collage will help students see the otherwise intangible step between fossil fuels and acid rain.

Class Organization

Class Organization:

Entire class working cooperatively in the classroom

Materials

Materials:

Wide range of magazines
Scissors
Glue
Black Markers
24" x 36" piece of light colored tagboard
12" x 18" piece of paper

Prior to Activity

Prior to the Activity:

Have the students read the following sections of the student reader:

"Fossil Fuels", "Air Pollution", and "Superstacks".

Label the tagboard "Air Pollution".

Procedure

Procedure:

Begin by asking these questions:

1. What are fossil fuels? Where do they come from?
2. How do we get energy from them?
3. What happens when they are burned?
4. What does air pollution look like? Where have you seen it?

5. What are some natural sources of air pollution?

On the 12" x 18" piece of paper, cooperatively list objects that cause air pollution. (Hint: car, airplane, volcano, power plant, etc.) Post the list where students can refer to it. Ask students to look through magazines at home for pictures of air pollution and its sources. Remind them to have permission to cut out the pictures. Explain that they will bring the pictures to class and glue them on the tagboard to create a collage titled "Air Pollution".

When a few pictures have been brought in, demonstrate how the pictures should be trimmed and then glued on the tagboard so the edges of the pictures overlap. The title area should remain free of pictures. The sources of objects could be outlined with black marker in order to give a unified look to the collage.

As students find pictures, they should add them to the collage. Encourage variety by reviewing the list of objects that cause air pollution.

When the collage is completed or the collection of pictures is depleted, discuss these questions:

1. Does this collage include all the sources of air pollution? Why or why not?
2. What did you learn about the causes of air pollution?
3. How might air pollution be reduced?
4. How can you help reduce air pollution?

Extensions

Extensions:

--Display the collage for others to see.

--Create a collage of newspaper clippings about acid rain. Underline the words "acid rain" each time they appear in the article.

--Instead of using pictures from magazines, have students draw pictures and use these for the collage.

--Make a collage of air pollution poems or limericks.

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Aquatic Organisms

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

Two periods of 45 minutes each

Objective

During this activity, students will:

1. Study several aquatic organisms
2. Make paper models of the organisms
3. Hang the models in the correct pH area of a display

This activity creates a display which shows the relationship between pH levels and the diversity of certain aquatic organisms. NOTE: The display is a representation and is not strictly accurate scientifically.

Class Organization

Groups of 2-4 students working in the classroom

Materials

7 paper raindrops, 8-9" tall
References with pictures of aquatic organisms, such as Fishes, by H. S. Zim and Pond Life, by G. K. Reid and H. S. Zim
Lightweight white paper
Watercolors and marking pens
Scissors, staples, string, tape
Stool or small ladder
Data sheet for each group

Prior to Activity

Have students read the following sections of the student reader:

"Acid/Neutral/Base", "pH Scale", "Acid Rain", "Aquatic Organisms", and "Indicators".

Make raindrops and number them according to data sheet. Hang them from the ceiling or light bank as shown on data sheet.

Procedure

Begin by asking students these questions about pH levels and aquatic organisms:

1. What is an aquatic organism? Give examples.
2. Would aquatic organisms be affected more by acid rain than land organisms? If so, Why?
3. Would all aquatic organisms be affected by acid rain in the same way? Would some be more sensitive than others? Why?

Lakes and streams usually range about pH 3 to 10 in round numbers, but very few at the extremes. Lakes in Minnesota, Wisconsin, North Dakota and South Dakota range from 5.0 to 9.6. Some bog pools may go down to about 4 or a little lower. (Gorham et al., L & O, 1983, Vol. 28, p. 292.)

Explain to students that they will be working in small groups to make models of aquatic organisms, or "critters", ("Critters" can be used in this activity.) The critters will be hung between the pH raindrops to show the pH range in which they can live and grow.

Pass out data sheets and discuss the critters listed. Point out that different numbers of different kinds of organisms will be made. Also explain that each kind has a "critical pH value." This is the lowest pH where the organisms can generally be found; at lower pHs, it usually cannot live.

Recognizing that making 5 brook trout takes more time than making two clams or 6 waterboatmen. Divide students into groups of various sizes. Assign an organism to each group. Each group should use available references to find the size, shape, color, and features of its animal.

Go through the following steps in creating an animal with your students:

1. Draw the life-size animal.
2. Cut out two shapes for each animal; CUT JUST ONE OF EACH WATERBOATMAN, SNAIL, AND DAPHNIA. These animals will not be stuffed because of their small size.
3. Paint the shapes. (Remind students that the shapes must fit together as front and back sides.)
4. Add features, such as eyes and fins, with marking pens after the paint has dried.
5. Staple around the edges, leaving an open area to stuff the organism with scrap paper.
6. Stuff, and staple the open area shut.
7. Attach a string.

Give students time to research and make their models. Encourage an assembly line process if a group is struggling with the task. Help the groups hang their animals as shown on the data sheet.

Discuss the display when it is finished:

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

1. Review terms such as pH, acid, and critical pH value.
2. Call on each group to point out their organism and tell the lowest pH that it can live in.
3. What animals are most sensitive to pH? Least sensitive? What does the display show about pH levels and the variety of kinds of aquatic organisms?
4. At what pH level are there the most different kinds of organisms? The fewest different kinds? Identify those levels as being more acid or less acid.
5. If you like to fish, should you be concerned about the effect of acid rain on lakes and streams? Would you rather fish in water with a pH near 7 or a lower pH? Why?
6. If you were a bear or an eagle that ate fish, which lake would you live near--one with a low pH or a higher pH? Why?

Extensions

--The display may also be mounted on a bulletin board which has been divided into pH areas. Students could create an aquatic environment as a background for the display.

--Invite other classes to your room and explain your display to them. A sign on the door that says "Why are all those organisms hanging from the ceiling?" might attract curious people.

--Contact your local newspaper and ask if they are interested in sharing this project with their readers.

--Identify and research local fish species. Contact your local or state Department of Natural Resources for descriptive information and critical pH values for each fish.

--Have students create a three-dimensional acid- resistant fish, and give it a name. Why might one try to breed such a fish? Are there problems with using this as a solution to lake acidification problems? Encourage the students to share their model with the class.

6 DATA SHEET

AQUATIC CRITTERS

The finished display shows the critters hanging in the pH range where they can live and grow

4	4.5	5	5.5	6	6.5	7
Water boatman	Water boatman eel brook trout	Water boatman eel brook trout salamander northern pike perch	Water boatman eel brook trout salamander northern pike perch whitefish daphnia salmon	Water boatman eel brook trout salamander northern pike perch whitefish daphnia salmon snail clam crayfish	Water boatman eel brook trout salamander northern pike perch whitefish daphnia salmon snail clam crayfish	Water boatman eel brook trout salamander northern pike perch whitefish daphnia salmon snail clam crayfish

BEST COPY AVAILABLE

REFERENCES

"Acid Rain—How Great a Menace?" National Geographic. November, 1981.

Acidification Today and Tomorrow. Swedish Ministry of Agriculture, 1982.

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Language Arts
Science

Acid Rain Editorial Cartoons

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

One period of 45 minutes

Objectives

Objectives:

During this activity, students will:

1. Interpret editorial cartoons relating to acid rain
2. Review the effects of acid rain

Acid rain has been the topic of numerous editorial cartoons. While recognizing the seriousness of the problem, this activity takes a lighter look at acid rain by examining editorial cartoons relating to acid rain.

Class Organization

Class Organization:

Total class presentation in the classroom

Materials

Materials:

Copies or transparencies of editorial cartoons
A newspaper that includes an editorial page
Writing paper
Pencils

Prior to Lesson

Prior to the Lesson:

Have students read the following sections of the student reader:

"Acids/Neutral/Base", "pH Scale", "Acid Rain", "Buffering", "Aquatic Ecosystems" and "Food Chain"

Procedure

Procedure:

Introduce editorial cartoons to the students by discussing the cartoon #1 labeled "This must be one of those lakes that show the effects of acid rain." Either pass out copies or view a transparency of the cartoon.

Discuss the following:

1. How is an editorial cartoon similar to a comic? Different than a comic?
2. Where are editorial cartoons found in a newspaper? (Show

an editorial page containing an editorial cartoon.)

3. Who is the cartoonist? This cartoon was found in what newspaper?
4. Is an editorial cartoonist illustrating a fact or an opinion?
5. Which are more important, the words or the pictures? Why?
6. Should editorial cartoons be interpreted literally, exactly as shown, or figuratively, as a representation of an idea? Why?
7. What effect of acid rain is illustrated in this cartoon? Does it really eat the flesh off the bone?

Using either individual copies or a transparency, discuss the editorial cartoon labeled "Rolaids" .

1. What is the setting of this cartoon?
2. Is the man fishing? Why not?
3. What does the headline in the paper mean? Is a "sour" lake acidic or basic? (Hint: Vinegar is sour.)
4. Why is the fish asking for Rolaids ? Is it practical to give fish Rolaids ? Why or why not?
5. What effect of acid rain is illustrated in this cartoon?

After looking at the cartoons, discuss these questions:

1. If you wanted true information about acid rain for a report, would you refer to editorial cartoons? Why or why not?
2. Why do people enjoy editorial cartoons?
3. What words would describe editorial cartoons? (Hint: biased, exaggerated, funny)
4. Would it be easy or difficult to draw an editorial cartoon?

Extensions

Extensions:

--Begin a classroom collection of editorial cartoons that focus on acid rain. Consider using them on a bulletin board.

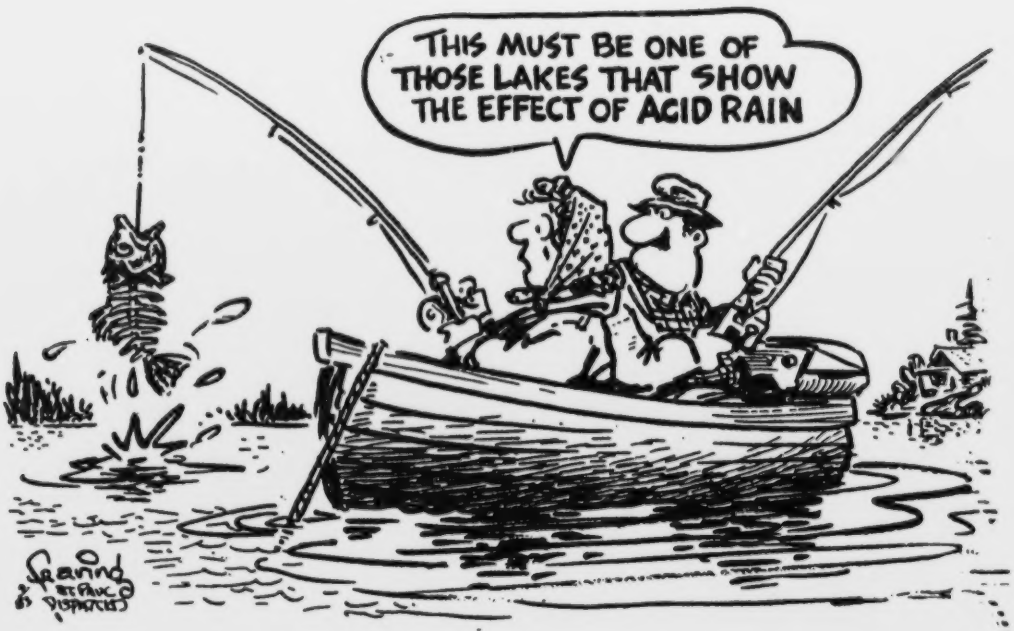
--Have students design an editorial cartoon relating to acid rain or another environmental problem of their choosing.

--Encourage students to bring in newspaper and magazine articles relating to acid rain. Display on a bulletin board backed with large cutouts of raindrops. Students could also re-write the article in their own words.

--Have students write an interpretation of one cartoon and share their ideas orally.

* Thank you! Permission was granted by Jerry Fearing, St. Paul Dispatch and Pioneer Press, St. Paul, MN, to use his two cartoons mentioned above.

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122



BEST COPY AVAILABLE

* Thank you! Permission was granted by Jerry Fearing, St. Paul Dispatch and Pioneer Press, St. Paul, MN, to use his two cartoons mentioned above.

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Fossil Fuels

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

Two periods of 45 minutes

Objective

During this activity, students will:

1. Relate fossil fuels to their own energy usage
2. Inventory the machines and appliances in their homes

This activity will help students see the relationship between their energy consumption and the burning of fossil fuels.

Class Organization

Total class discussion in the classroom. Students working individually at home and in the classroom.

Materials

Copies of fossil fuels worksheet

Prior to Activity

Have students read the following sections of the student reader:

"Fossil Fuels", "Air Pollution", and "Solutions".

Call the power company which supplies electricity to your community. Find out what fuel is used to produce electricity.

Complete your own fossil fuel worksheet.

Procedure

FIRST PERIOD

Begin by discussing these questions:

1. Most of the pollution that causes acid rain comes from burning fossil fuels. Where do the fuels come from? Name them.
2. Is electricity a fuel? How does using electricity contribute to pollution?
3. Let's list the machines and appliances we used this

morning before coming to school. (Write names on the board as given. Remind students about furnaces, stoves, hot water heaters, cars and buses.)

4. What are the energy sources of these machines and appliances? (Answers could include electricity, fuel oil, natural gas, gasoline, coal, and others).
5. Are the supplies of fossil fuel endless? Coal, oil, natural gas are "fossil sunlight", and we are using these faster than sunlight energy is being "fossilized" in the form of buried plant remains.
6. What are some forms of energy that do not involve burning fossil fuels?

Pass out worksheets. Elaborate on the fossil fuel columns:

1. If coal is burned to produce electricity in your area, have students write "electricity" under coal. (Put electricity in the appropriate column).
2. Have students write gasoline, diesel fuel, and propane under oil.
3. Under "Other" write the forms of energy brought out in the discussion period. (Wind, solar power, kid power, running water, nuclear energy).

Explain to students how you filled out your worksheet, i.e., walking from room to room, writing the names of machines and appliances in the right column. Remind them not to overlook the garage and basement. The worksheet could be taken home and completed with the help of parents, if needed, and brought back to school.

SECOND PERIOD

Discuss the completed worksheets:

1. Which column filled up the fastest?
2. Who would like to read their coal column? Natural gas column? Oil? Did anyone use another type of energy?
3. How did you know what the source of energy was? Are there any machines or appliances you didn't know where to place?
4. Consider which five of the entries are most important to you, and circle them. (Ask students to share their choices).
5. Consider which five of the entries are least important to you, and check them. (Ask students to share their choices.
6. How did the pioneers meet the needs of those five you circled as most important?
7. Can you use less of them without real hardship?
8. Acid rain is caused by the air pollution from fossil fuels. How can we help the problem of acid rain?

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Extensions

--Have students pretend that a storm has left them without electricity for three days. How would they manage? Go through their "electricity" column and think of substitutions. Consider different seasons.

--Have students create a visual display, depicting the various fossil fuels in stages as plants, changing into fossil fuel over time.

--Display the worksheets, or transfer all the energy users to a bulletin board, and keep adding to it for the duration of the acid rain study unit.

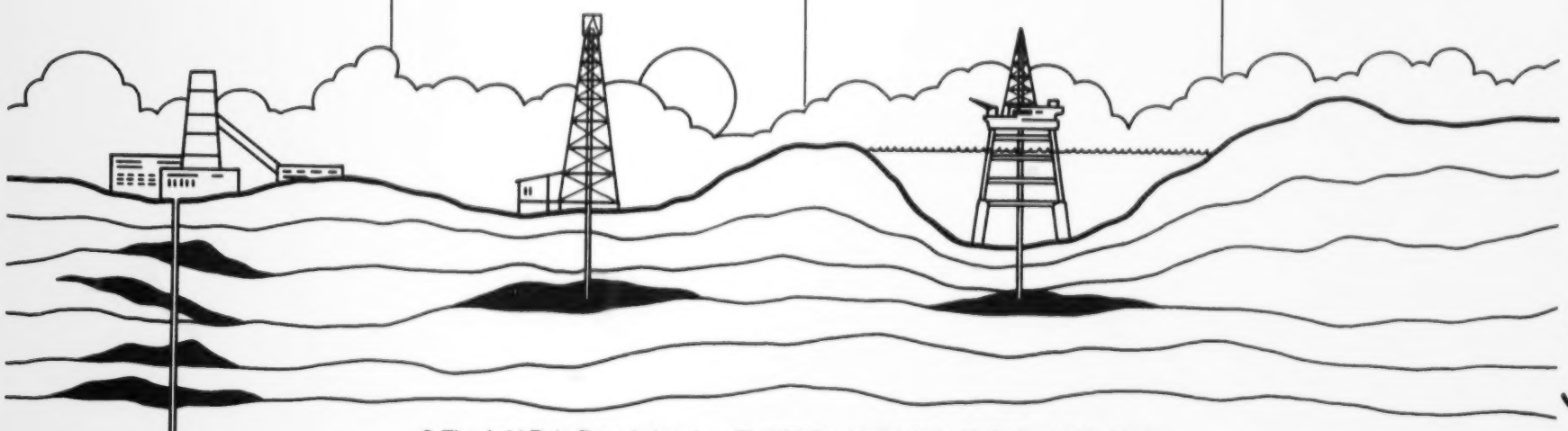
--Transfer the names of the machines and appliances to adding machine tape and see how many times it goes around the classroom.

WORKSHEET

FOSSIL FUELS

HOW ARE THEY USED IN YOUR HOME?

COAL	OIL	NATURAL GAS	OTHER



(Use the back if you need more space) →

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

BEST COPY AVAILABLE

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Social Studies
Science

Futures Wheel

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

Two periods of 45 minutes each

Objective

Objectives:

During this activity, students will:

1. Learn how to develop a futures wheel
2. Create a futures wheel to explore the effects of acid rain

Students will explore the effects of acid rain beyond the initial impact on aquatic and land ecosystems.

Class Organization

Class Organization:

Groups of 4-6 students working in classroom

Materials

Materials:

Individual copies of sample futures wheel
Large sheet of paper (36" x 36") and marking pen for each group

Prior to Lesson:

Have students read the following sections of the student reader:

"Water Cycle", "Fossil Fuel", "Air Pollution", "Superstacks", "Acid Rain", "Aquatic Ecosystems", "Food Chain", "Land Ecosystems", and "Solutions".

Procedure

Procedure:

The futures wheel is a teaching tool that encourages students to think creatively in exploring the implications of a particular topic. There are no right answers. It is not a decision-making tool.

PERIOD ONE

Pass out the individual copies of the sample futures wheel. Refer to the sample when necessary to clarify the following guidelines as you explain them to the class.

Guidelines for Futures Wheel

1. Divide the students into groups and have each group select a recorder.
2. The recorder writes the topic of the futures wheel in the center of the paper and circles it.
3. The group asks the question "What might happen if...?" They try to give three to five responses to that question and the recorder writes them around the center circle. All responses are to be written down without discussion or evaluation in order to encourage creative thinking. These are first order connections. They should be circled and connected to the center circle with one line.
4. Then ask the question "What might happen if...?" of the first order connections and place those responses around each of the first order connections. Circle them and connect these second order connections to the first ones with a double line.
5. Continue with the third order connections. Depending on the topic and the ability of the students, the wheels could be carried out to fourth and fifth order connections. However, third order is a good level to stop for beginning experiences with futures wheels.
6. Try to think of both positive and negative connections. They may be labeled good (+), bad (-), or neither (n).

After discussing the guidelines with the sample futures wheel, you might continue the spokes of the sample. If you feel the students need more practice before beginning the acid rain futures wheel, have them do another wheel on a topic they can easily identify with, such as "What might happen if we had school six days a week instead of five?"

PERIOD TWO

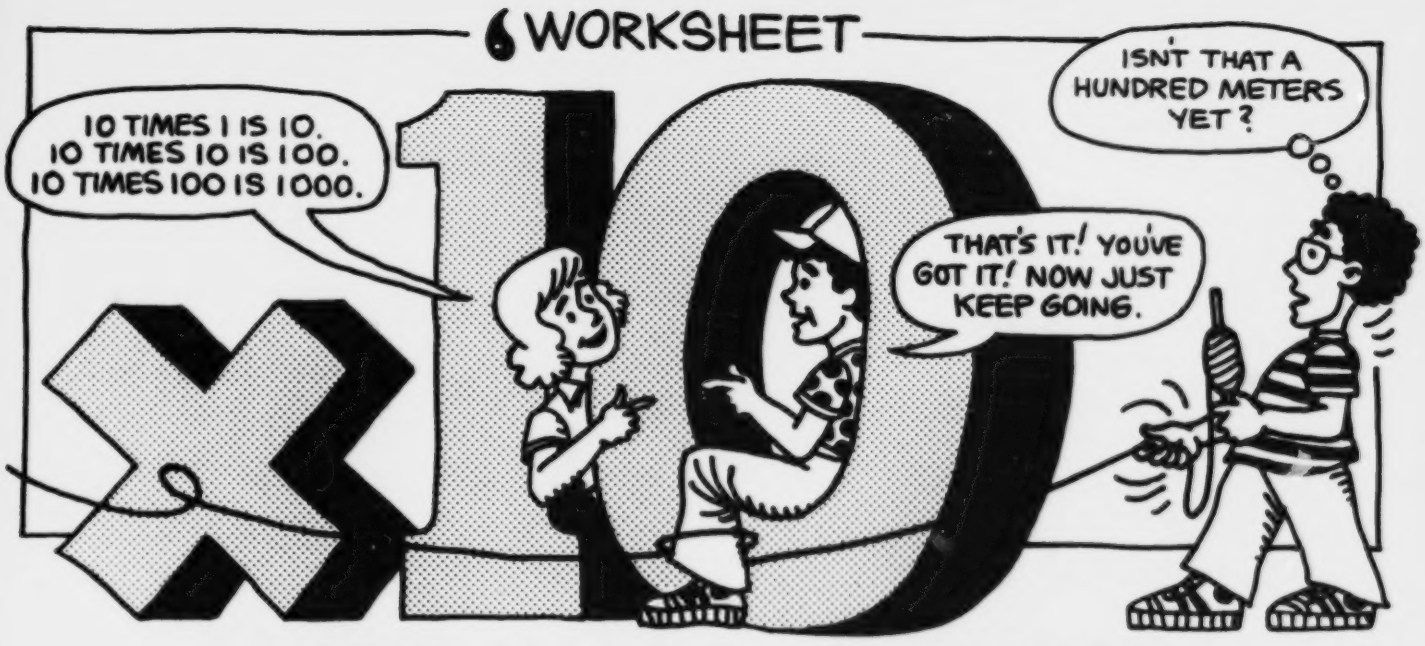
When you feel the students understand the basic process of developing a futures wheel, have them begin a futures wheel for the purpose of exploring the effects of acid rain. Divide the students into groups and give each group one of the large sheets of paper. The recorder should label the center circle "Acid Rain." The question for the first order connections should be "What might happen if acid rain continues?" Give hints on the process as you monitor the groups.

When the groups have carried their wheels out to the designated order or reached the time limit, discuss the results as a class:

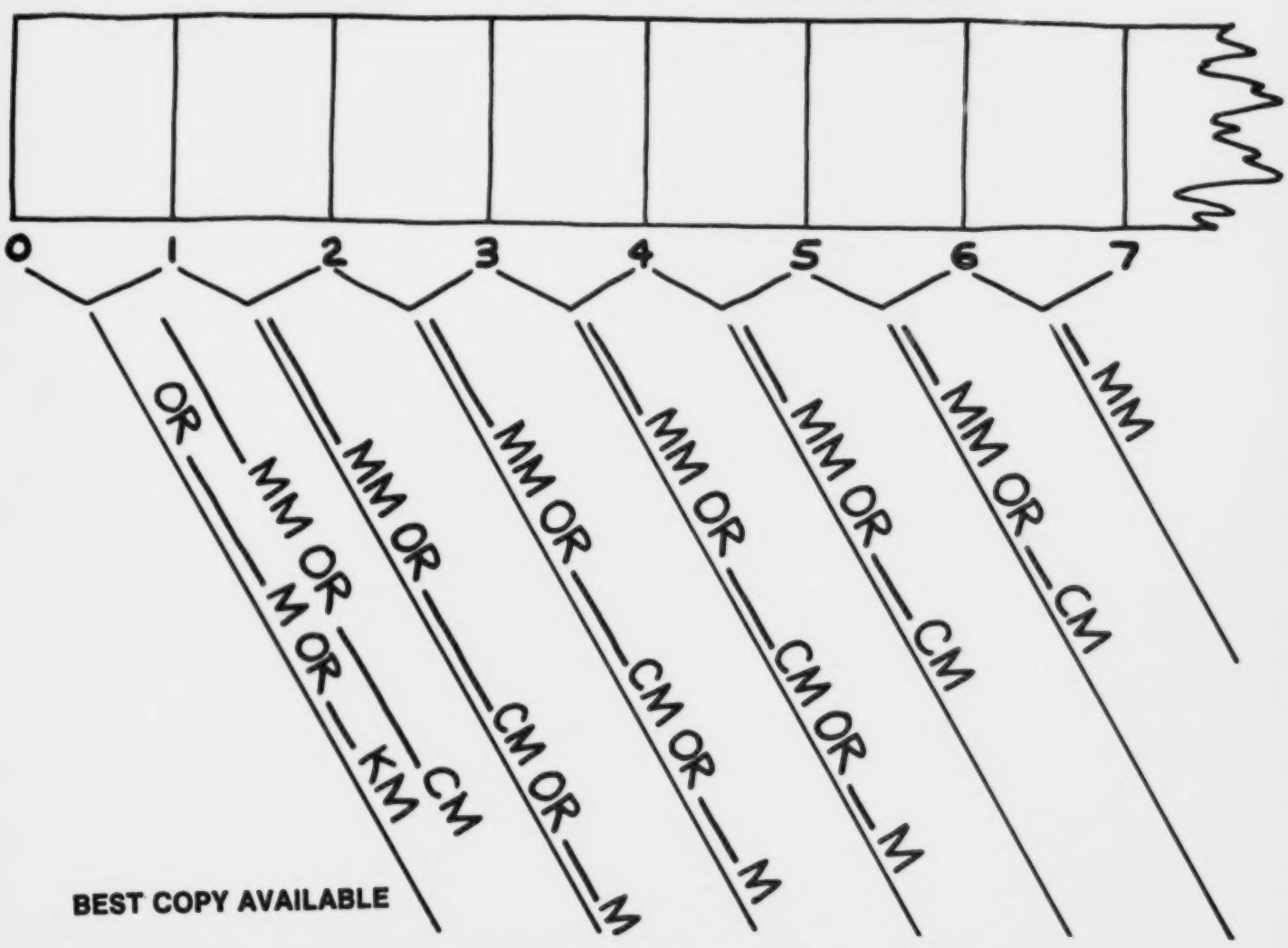
1. Ask each group to share their most creative "spoke" and/or an especially threatening "spoke."
2. Questions: Are the effects of acid rain very narrow or very broad? What can we say about the effects of acid rain when they are extended in a futures wheel?
3. Display the wheels and allow students to look for similarities and differences.

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

WORKSHEET


10 TIMES 1 IS 10.
10 TIMES 10 IS 100.
10 TIMES 100 IS 1000.
ISN'T THAT A HUNDRED METERS YET?
THAT'S IT! YOU'VE GOT IT! NOW JUST KEEP GOING.
x10

LOGARITHMIC PH VALUES



BEST COPY AVAILABLE

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

Extensions

--Regroup the students and develop another acid rain futures wheel. Are these more complete than the first ones? Are they more creative?

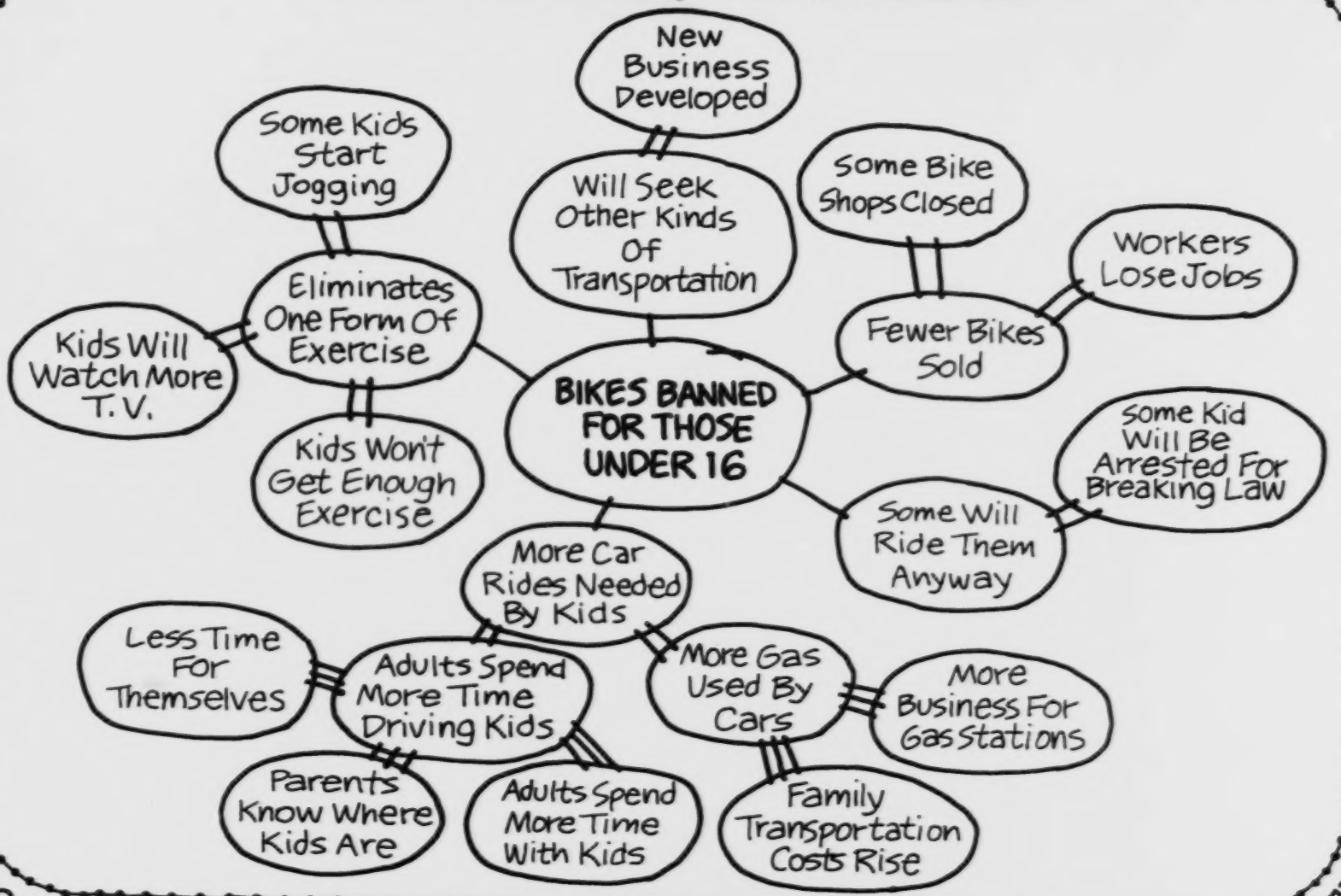
--Ask the students to develop a futures wheel at home with their family. The wheel could either deal with acid rain or a topic of special interest to the family, such as whether or not to get a pet. Invite the students to bring these wheels to school to display.

Thank you! The futures wheel was developed by Jerry Glenn, a Professor at The University of Massachusetts. Joel Barker, Infinity Limited, St. Paul, has enhanced and refined its use.

DATA SHEET 6

FUTURES WHEEL

WHAT MIGHT HAPPEN IF...? WHAT COULD POSSIBLY HAPPEN NEXT? WHAT ELSE MIGHT HAPPEN ¿ HM-M-M... LET'S SEE WHAT MIGHT HAPPEN IF...WHAT WOULD HAPPEN AFTER THAT ? WHAT DO YOU THINK WOULD HAPPEN IF....?


BIKES BANNED FOR THOSE UNDER 16
New Business Developed
Will Seek Other Kinds Of Transportation
Some Kids Start Jogging
Eliminates One Form Of Exercise
Kids Will Watch More T.V.
Kids Won't Get Enough Exercise
Some Bike Shops Closed
Fewer Bikes Sold
Workers Lose Jobs
Some Kid Will Be Arrested For Breaking Law
Some Will Ride Them Anyway
More Car Rides Needed By Kids
Less Time For Themselves
Adults Spend More Time Driving Kids
Parents Know Where Kids Are
Adults Spend More Time With Kids
More Gas Used By Cars
More Business For Gas Stations
Family Transportation Costs Rise

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

BEST COPY AVAILABLE

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Language Arts
Social Studies

Letter Writing

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

Two 45 minute class periods

Objective

Objectives:

During this activity, students will:

1. Learn the proper form of a business letter
2. Express their personal concerns and/or questions about acid rain in a letter to a government, business or organization leader.

Writing letters to leaders in government, business, or organizations is a way students can show their concern and interest in acid rain. Completed letters should be sent and students should be encouraged to share their replies with the class.

Class Organization

Class Organization:

Students will work individually

Materials

Materials:

Transparency or individual copies of sample business letter
Transparency or individual copies of data sheet of addresses
Pencils, paper, envelopes, stamps

Prior to Lesson

Prior to Lesson:

Have students read the following sections of the student reader:

"Water Cycle", "Fossil Fuel", "Air Pollution", "Superstacks", "Acid Rain", and "Solutions".

Additional selections may be appropriate, depending on the concerns of the students.

Complete the data sheet, adding names and addresses for people to contact. If you need assistance, call your public library. Blanks are for businesses and/or organizations of special importance in your area.

Procedure

Begin by discussing these questions:

1. What are some effects of acid rain?
2. How might acid rain affect you?
3. How do you feel personally about acid rain?
4. Who makes the laws controlling air pollution?
5. How do lawmakers make their decisions about laws?
6. Who has a right to tell lawmakers, businesses, and organizations about their concerns?
7. What responsibilities do informed citizens have?

In the first class period, review the proper form of a business letter using an overhead transparency or individual student sheets.

Provide names and addresses of government, business and organization leaders, by way of the transparency or individual data sheets.

Have each student write a business letter. Encourage students to share their concerns and/or questions about acid rain. If students have suggestions of ways to reduce acid rain, they should be encouraged to include these in their letters.

Remind students that short, carefully written letters will receive more attention than carelessly written letters. Allow students to express their own ideas in the letters.

Use the second class period to proofread and recopy letters and address envelopes.

When responses are received and shared, questions for discussion might be:

1. How are the letters received different from those written in the classroom? How are they alike?
2. Have the leaders agreed or disagreed with your letters? Have they answered your questions?
3. Why might some leader not respond to the letters?

Extensions

Extensions:

--As a class, write a business letter to an organization or business that has information available on acid rain. BE SPECIFIC IN YOUR REQUEST AND SEND JUST ONE LETTER TO ANY ONE SOURCE.

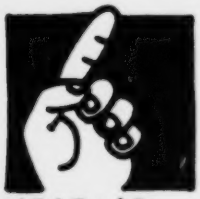
--Students might write follow-up letters to those who responded to their first letters. Encourage students to re-emphasize their interest in acid rain and to respond to what the official has written.

--As a class, write a letter to a local or national weather service, television or radio station, or newspaper, asking that pH readings be given whenever precipitation is reported.

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

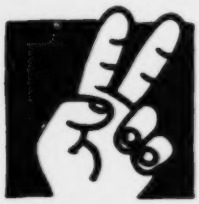
DATA SHEET

A Business Letter HAS 6 PARTS



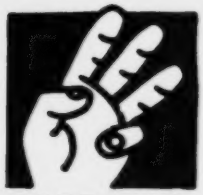
HEADING

Wilder Elem. School
609 Oak Street
St. Paul, MN 55401
May 4, 1984



INSIDE ADDRESS

Senator
U.S. Senate
Washington, D.C. 20510



GREETING

Dear Senator :

BODY

CLOSING

Sincerely,
Matt Smith

SIGNATURE

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

BEST COPY AVAILABLE

data sheet

Business or Organization Leaders

Coal Company

Utility Company

Your State

Zip Code

State Environmental Organization

Your State

Zip Code

National Environmental Organization

Zip Code

Canadian Official

Swedish Official

Zip Code

Local Librarian

Street, Box No.

City State

Zip Code

State Government Agency

Street, Box No.

City State

Zip Code

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

data sheet

Government Officials

National Officials

Your Representative in the House

House of Representatives

Washington, D.C.

20515

Your Senator

U.S. Senate

Washington, D.C.

20510

The President

The White House

Washington, D.C.

20500

Name

Street, Box No.

City State

Zip Code

State Officials

Your Representative in the House

House of Representatives

Your Capitol Your State

Zip Code

Your Senator

State Senate

Your Capitol Your State

Zip Code

Your Governor

State Capitol

Your Capitol Your State

Zip Code

Name

Street, Box No.

City State

Zip Code

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Logarithmic pH Values

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

One period of 60 minutes

Objective

During this activity, students will:

1. Compute the logarithmic change (progression) on the pH scale
2. Represent the changes as distances on a string

Students will develop a logarithmic progression. It will help them understand the logarithmic pH scale and the meaning of changes in pH. The logarithmic progression is a representation appropriate for upper elementary students, but is not mathematically accurate.

Class Organization

Students working individually or as a class, first in the classroom and then moving into a larger area such as a playground.

Materials

Copy of worksheet for each student
Meter sticks (2-4) or a metric trundle wheel (check with the secondary physical education department for this)
Ball of string at least 100 m long
Seven tagboard signs (8-1/2' x 11") numbered 1 to 7
Short lengths of string
pH scale of 1-14

Prior to Lesson

Have students read the following sections of the student reader:

"Acid/Neutral/Base," "pH Scale," and "Acid Rain"

Punch a hole in the top center of each sign and attach a piece of string to prepare the signs to be hung at measured distances.

Procedure

Ask students these questions about the pH scale:

1. How are acids and bases measured?
2. What method (tool) is used to measure pH?
3. What does the pH value tell about a liquid?

Displaying a pH scale, identify the areas of acidic, neutral, and basic solutions. Explain that this activity will focus on pH 7 to 0.

Use this statement--or restate it in your own words--to explain the pH scale to your students:

> The pH scale is designed so that each decrease of one unit represents a 10-fold increase in acidity. This increase is called a logarithmic progression. If you can multiply by ten, you can work out a logarithmic progression. For example, pH 6 is 10 times more acidic than pH 7, and pH 5 is 100 times more acidic than pH 7. The pH scale shows this increase in two units rather than in 100 units. The pH scale is a space saver.

Explain to students that they will be measuring and marking distances on a string so they will be able to see the 10-fold increases in a logarithmic progression.

Pass out worksheets, explaining that the distances between each pair of pH values must be calculated before the distances can be measured. Depending on students' understanding of metrics, have them complete the worksheets individually or together as a class. Point out that the first two distances have been done for them. Reduce millimeters and centimeters for easier measuring, when possible.

Check answers before beginning measurements:

pH 7 to 6	1 mm			
6 to 5	10 mm/	1 cm		
5 to 4	100 mm/	10 cm		
4 to 3	1,000 mm/	100 cm/	1 m	
3 to 2	10,000 mm/	1,000 cm/	10 m	
2 to 1	100,000 mm/	10,000 cm/	100 m	
1 to 0	1,000,000 mm/	100,000 cm/	1,000m/	1 km

Give 7 students a single pH value sign. Assign two students to unwind string across the classroom. Have student place the sign for pH 7 at the end of the string. Measure the first distance (1 mm) and hang the sign for pH 6 at this point.

Repeat this process for each of the other distances. Have students unwinding the string and measuring trade off with other students. At longer distances, having 3-4 students measuring will speed the process if meter sticks are used. When students are not

actively involved, they should follow the process on their worksheets.

* Note There is not enough room in a classroom to be able to finish this activity. Perhaps you could move outside to go down to pH 1, or stop when you run out of room inside.

After the measuring is completed to pH 1, (or as far as you could go) point out that pH 0 would be 1 kilometer from pH 1. Take time to look at the large distances between the low pH values. Remind students that the distances they calculated and measured represent increases in the strength of an acid on the pH scale.

Discuss the following questions about logarithmic progression with your students:

1. How is a logarithmic change different from a regular unit change?
2. What happened to the distance as pH values became lower? What do those distances represent?
3. If the pH of a lake changes from pH 6 to pH 4 over a period of years, how much more acidic has the lake become?
4. Why is it important to know that pH values are logarithmic?
5. A person says that a rainfall of pH 4.6 is only a little more acid than a normal rainfall of pH 5.6. What do you tell this person?

Extensions

--Have students look through acid rain materials for the pH values of geographic areas, bodies of water, or ordinary solutions. Make signs and hang them in the correct place on the string.

--Create a display of the pH scale as a logarithmic progression with string by running it back and forth across a bulletin board, wall, or hallway.

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Measuring pH of Rain

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

Three periods of 30 minutes; several periods of 5-10 minutes

Objective

During this activity, students will:

1. Collect samples of local rainfall
2. Test the pH value of the samples

Students will test samples of local rainfall to see if it is "acid rain". The testing results are appropriate for upper elementary students, but may not be strictly accurate scientifically.

Class Organization

Groups of 6-8 students working in the schoolyard and classroom.

Materials

Copies of data sheet
New plastic containers, soaked in distilled H_2O, emptied, and then put in plastic bag for storage
Raincoats!
pH paper (pH 3 to pH 6) and color charts
Plastic bags (bread size)
Masking tape, pens

Prior to Activity

Have students read the following sections of the student reader:

"Acid/Neutral/Base", "pH Scale", and "Acid Rain".

Procedure

FIRST PERIOD:

Begin by asking these questions:

1. What does pH mean?
2. What is the pH of normal rain? Is it acid or base?
3. At what pH level is precipitation called "acid rain"?

4. What are the different forms of acid rain?
5. Is it dangerous to go out in acid rain?
6. How is the pH of a liquid measured?

Divide the students into several groups of 6-8 and pass out data sheets. Number groups and have them fill in names and group number.

Explain that they will be collecting and testing rain samples over a period of several weeks, and keeping a record of the results.

Give each group three glass containers and enough tape to number jars 1-3 and label with group number. Collect containers.

Take students outside to collecting area. Go through guidelines for collecting samples:

1. Two students from each group will place the collecting jars in the school yard. (Teachers must use good judgement in allowing students to collect samples during severe weather).
2. Place the jar in the open, away from chimneys and automobiles.
3. Place jar on a plastic bag to keep dirt from being splashed in.
4. Leave the jar outside until 1 centimeter (½ inch) of rain has been collected.
5. Try to collect samples several times during a rainfall.
6. The samples should be brought back to the classroom and tested immediately.

Explain that the activity will continue the next rainy day.

SECOND PERIOD

Review the collecting guidelines. Assign two students from each group to place (and occasionally check) the collecting jars.

When the first samples have been collected, demonstrate the steps in testing:

1. Dip a strip of pH paper into the rainwater. Stress the importance of using a new strip with each sample.
2. Match the wet pH paper to the color chart immediately and determine the correct pH value.
3. Record the results on the data collecting sheet, along with date, place, and sample number.

Allow groups to work together to test their samples. The samples can be discarded once they have been tested.

The collecting and testing can go on for several weeks, depending on the availability of samples and the interest of the students.

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

CONCLUDING PERIOD

Display the collecting sheets and discuss the results:

1. Can samples of the same rainfall have different pH values? Why?
2. What was the lowest pH recorded? Is that "acid rain"?
3. Scientists have usually found the rain at the beginning of a storm to be more acid than rain collected near the end. Did our samples show this to be true?
4. Would you expect the pH of rain to be higher or lower five years from now? Why?
5. Judging from our samples, what effect will our rain have on area lakes?

Extensions

--Encourage students to listen to weather reports and plan ahead for collecting periods.

--Check to see whether the local weather service monitors the pH of rainfall and snowfall. Compare the class' results with the station's results.

--Collect data throughout the school year. Compare from year to year.

DATA SHEET 6

MEASURING pH OF RAIN

GROUP # _____

STUDENTS

_____

_____

_____

_____

_____

_____

_____

_____

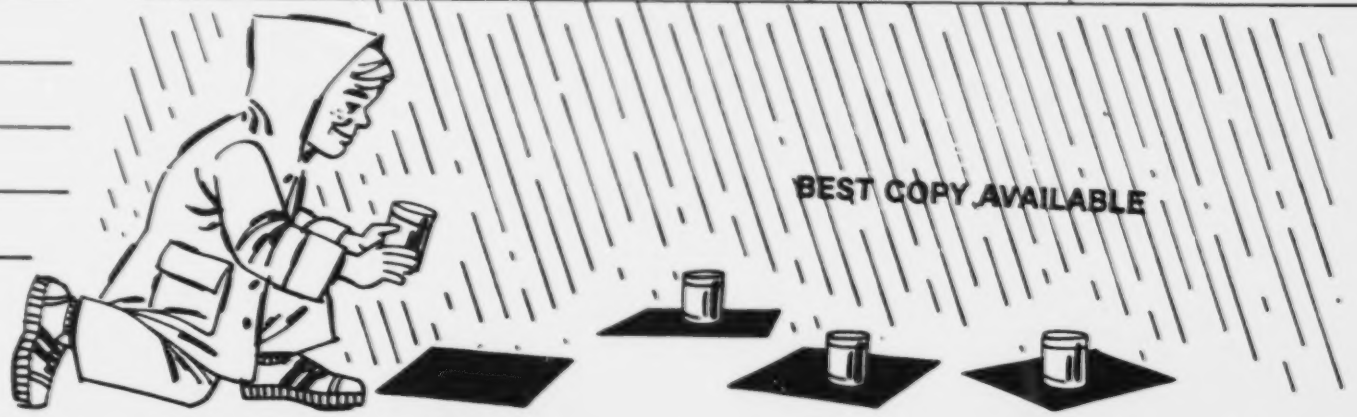
_____

_____

_____

_____

SAMPLE #	LOCATION	DATE	pH



BEST COPY AVAILABLE

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Measuring pH of Snow

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

Several periods of 30 minutes

Objective

During this activity, students will:

1. Collect samples of local snowfall
2. Test the pH value of the samples

Students will test samples of local snowfall to see if it is "acid". The testing results are appropriate for elementary students, but may not be strictly accurate scientifically.

Class Organization

Groups of 6-8 students working in the schoolyard and classroom

Materials

Copies of data sheet
pH paper (pH 3-pH 6) and color charts
Empty potato chip can or similar clean cylinder
Selfsealing plastic bags
Masking tape, pens

Prior to Activity

Have students read the following sections of the student reader:

"Acid/Neutral/Base", "pH Scale", and "Acid Rain".

Procedure

FIRST PERIOD

Begin by asking these questions:

1. What does pH mean?
2. What is the pH of pure rain? Is it acid or base? Is that true for pure snow?
3. At what pH level is snow called "acid"?
4. What are the different forms of acid rain?
5. Is it dangerous to go out into acid snow?
6. How is the pH of a liquid measured? How will we measure the pH of snow?

Divide the students into several groups of 6-8 and pass out data sheets. Number groups and have them fill in names and group number.

Explain that they will be collecting and testing snow samples over a period of several weeks, keeping a record of the results.

Give each group three selfsealing bags and enough tape to number them 1-3. Label each bag with group number.

Take students outside to collecting area. Go through guidelines for collecting samples:

1. Take the potato chip can and insert vertically into undisturbed snow. (Do not collect from snow that has been piled by shoveling or dirtied by chimney or automobile exhaust.)
2. Shake snow into plastic bag.
3. Collect from several areas around the school.

Allow student to collect samples. Samples will melt in the warmth of the classroom and should be tested immediately after melting.

Demonstrate the steps in testing:

1. Dip a strip of pH paper into the melted snow. Stress the importance of using a new strip with each sample.
2. Match the wet pH paper to the color chart immediately and determine the correct pH value.
3. Record the results on the data collecting sheet, along with date, location, and sample number.

Allow groups to work together to test samples. The samples can be discarded once they have been tested.

The collecting and testing can go on for several weeks, depending on the availability of fresh samples and the interest of the students. Also test different sites if students travel.

CONCLUDING PERIOD

Display the collecting sheets and discuss the results:

1. Can samples of the same snowstorm have different pH values? Why? Why do we take a vertical sample?
2. What was the lowest pH recorded? Is that "acid"?
3. Scientists have usually found the snow at the beginning of a storm to be more acid than that collected near the end. How could we check out that statement? Test different levels of the core.
4. Would you expect the pH of snow to be higher or lower five years from now? Why?
5. Judging from our samples, what effect will our snow have on area lakes this spring?

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Extensions

--Encourage students to listen to weather reports and plan ahead for collecting periods.

--Check to see whether the local weather service measures the pH of snowfall. Compare the class's results with the station's results.

--Collect data throughout the snowfall season, or compare rain and snow (collect rain in cleaned, or new, plastic buckets rinsed with distilled H_2O). Compare from year to year.

DATA SHEET

Measuring pH of Snow

Sample #	Location	Date	pH

Group #

Students: _____ _____

_____ _____

_____ _____

_____ _____

BEST COPY AVAILABLE

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

Science
Social Studies
Math

Neutralizing

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122 • (612) 455-7719

Time

One period of 45 minutes.

Objectives

During this activity, students will:

1. Observe a demonstration showing how a base can change the pH of an acid solution.
2. Relate their observations to natural bases and acid rain.

Students will observe that the base (baking soda, Alka Seltzer and/or Rolaids) raises the pH of the vinegar/water solution. It will help them understand how natural bases can neutralize acid rain in lakes and streams.

Class Organization

Total class presentation; in classroom.

Materials

Vinegar, (5% solution)
Water
Clear pint jar
Tablespoon measure
Baking soda, Alka Seltzer , and/or Rolaids
pH paper
pH scale

Prior to Activity

Have students read the following sections of the student reader:

"Acid/Neutral/Base", "pH scale", and "Neutralization".

In the pint jar, prepare a vinegar solution of 1 tablespoon vinegar to 5 tablespoons water.

Procedure

Begin by asking students these questions about pH values and neutralizing ability:

1. Is it possible to change the pH of a liquid? How might we raise the pH of an acid and make it a weaker acid?
2. What does it mean to "neutralize" an acid? (Hint: a pH of 7 is neutral.)
3. Certain rocks and soils neutralize the water around them. They are called basic. How do they react?

Explain to students that they will be observing an experiment to test whether a base can change the pH of an acid solution. Introduce baking soda, Alka Seltzer and/or Rolaids as the base that will be used in the demonstration.

1. What does antacid mean?
2. When would people take baking soda, Alka Seltzer and/or Rolaids ?
3. Does it make stomach acids more or less acid?

Show the vinegar/water solution and explain how it was prepared. Demonstrate the use of baking soda, Alka Seltzer and/or Rolaids as a base on the vinegar/water solution:

1. Test the pH of the vinegar solution with pH paper, and record the number on the board.
2. Drop in a tablespoon of baking soda, or two fresh Alka Seltzer tablets, or two Rolaids tablets and watch the action.
3. With a new strip of pH paper, test the solution when the bubbling action stops. Record the new pH value.
4. Locate the original and buffered values on a pH scale.

Discuss the following questions about the results.

1. Is the pH of the vinegar solution higher or lower after being neutralized by the baking soda, or Alka Seltzer , or Rolaids ? Is that more or less acid?
2. Limestone (a type of basic rock) is a natural neutralizer found in many areas. Acid rain is not as damaging to these areas. Why?
3. Granite (a volcanic rock) does not contain basic materials. Would these lakes be more susceptible to acid rain because they are unable to neutralize acids? Why or why not?

Worksheet Here

Introduce North American maps and sources of SO_2.

Extensions

Individual or groups of students may repeat the experiment and compare their results.

-- Test the neutralizing capacities of limestone and granite. Repeat the above demonstration, using crushed limestone and

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122 • (612) 455-7719

crushed granite in place of baking soda. Use separate containers that can be covered and shaken for each rock. Students can look through acid rain booklets and brochures for information on liming of lakes. (Find a map showing area sensitivity to acid rain and locate your area. Worksheet)

-- Make a list of substances found around your home that act as antacids or neutralizers. (Do not actually test any of these substances without talking with your teacher.)

-- How much does it cost to neutralize one cup of water with baking soda? with Alka Seltzer ? with Rolaids ?

-- Could scientists add baking soda/Alka Seltzer or Rolaids to neutralize an acid lake?

Hint: One typical lake in Minnesota = 100 acres, 10' average depth and contains approximately 3,000,000,000 gallons of water.

1 gallon = 16 cups

How much would it cost to neutralize an average Minnesota lake with Alka Seltzer ? with Rolaids ? (Agricultural limestone is less expensive).

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION

pH Scale

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

One 45 minute class period

Objective

During this activity, students will:

1. Test the pH of a variety of solutions
2. Place their findings on a pH scale

In this activity students will work with pH paper, a variety of solutions, and the pH scale to understand acids and bases. Results will not be scientifically exact and may vary from group to group. Variation may result from age of pH paper, color perception, and strength of solutions.

Class Organization

Groups of 4-6 students working in the classroom.

Materials

For each group:

- Copy of data collecting sheet
- Copies of pH scale
- Different types of pH testing paper (wide and short range) and color chart
- Paper cups for distributing solutions
- Labeled solutions such as lemon juice, vinegar, citric acid, orange juice, baking soda solution, soda pop, limewater, salt water, rain, melted snow, distilled water, tap water, antacid solution. (Note: colorless solutions are easiest to test.)

Prior to Activity

Have students read the following sections of the student reader:

"Acid/Neutral/Base" and "pH Scale".

Label a paper cup for each solution to be tested. Pour about 1 cm of solution into its labeled container. Have at least as many solutions as student groups. Arrange solutions, pH paper and color charts at several "testing stations" in the classroom.

Safety Precaution

1. Use only identified solutions for testing.
2. Do not include dangerous solutions such as sulfuric and hydrochloric acid or full strength ammonia.
3. Tell students not to drink or taste any of the solutions.
4. Do not have any food near testing stations.

Procedure

Begin by asking these questions about pH values:

1. How is the pH of a liquid measured?
2. What is the range of the pH scale?
3. What is the range of acids? Of bases? What is neutral on the pH scale?

Divide students into groups of 4-6 and pass out the data collection sheets and pH scale worksheets.

Demonstrate the steps the students will be taking to test the solutions:

1. Dip a strip of pH paper into the solution. Stress the importance of using a new strip with each solution.
2. Match the wet pH paper to the color chart immediately.
3. Record the results on the data collection sheet.
4. Write the name of the solution in the proper place on the pH scale worksheet.

Explain to students that they will move as a group from station to station with their data sheet and pH scale worksheet, until they have been to each station.

When students have tested the available solutions, review the results plotted on the pH scale worksheets:

1. Which solutions are acid? Bases? Neutrals?
2. How does the pH paper indicate the pH of each solution?
3. Did each group have the same pH numbers for the solutions? Why? Why not?

Extensions

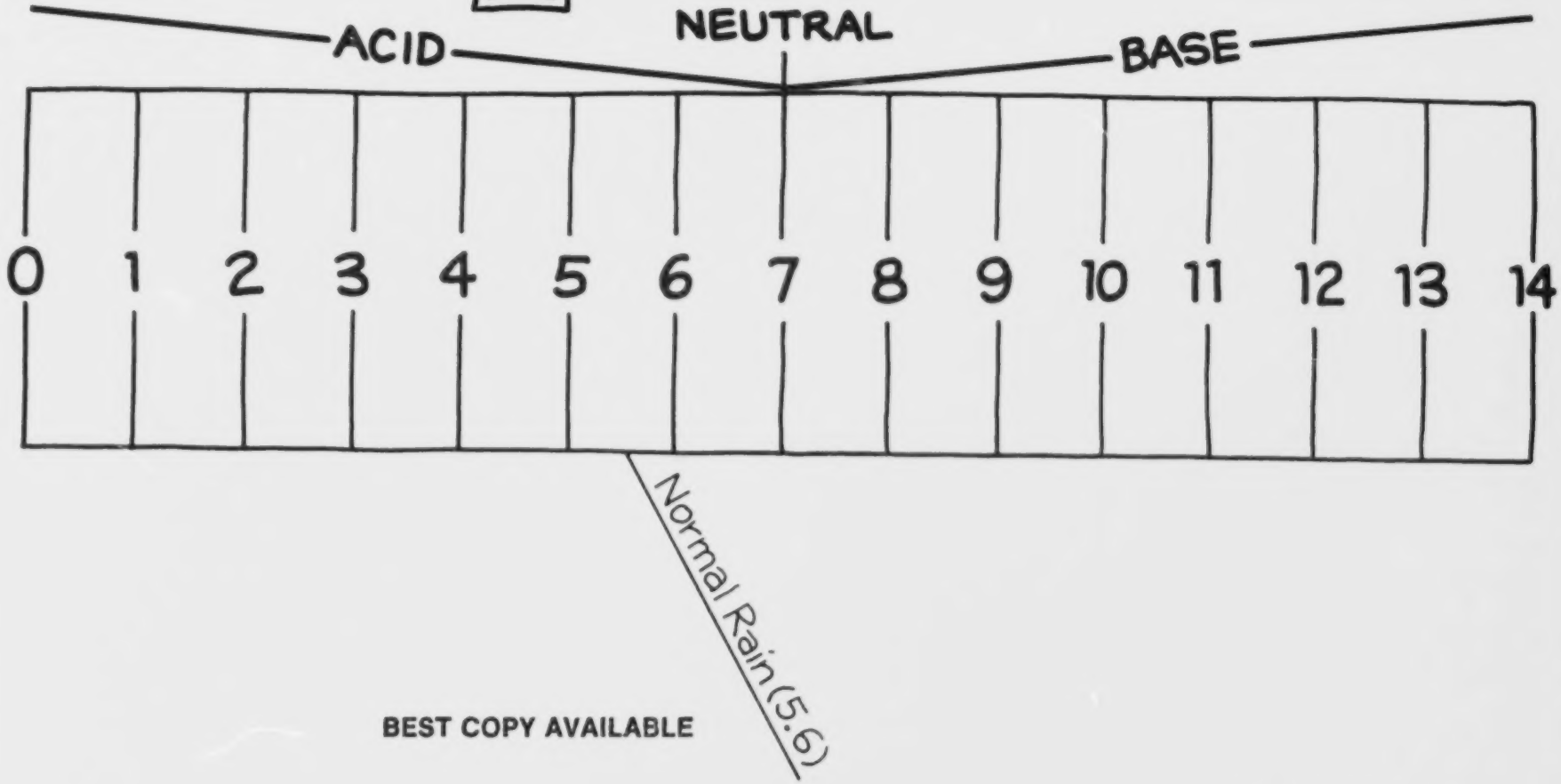
--Use solutions of rocks crushed with a hammer. Compare. Example: granite, limestone.

--Use unlabeled solutions. Can students identify solution by pH? Or other properties?

©The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

WORKSHEET

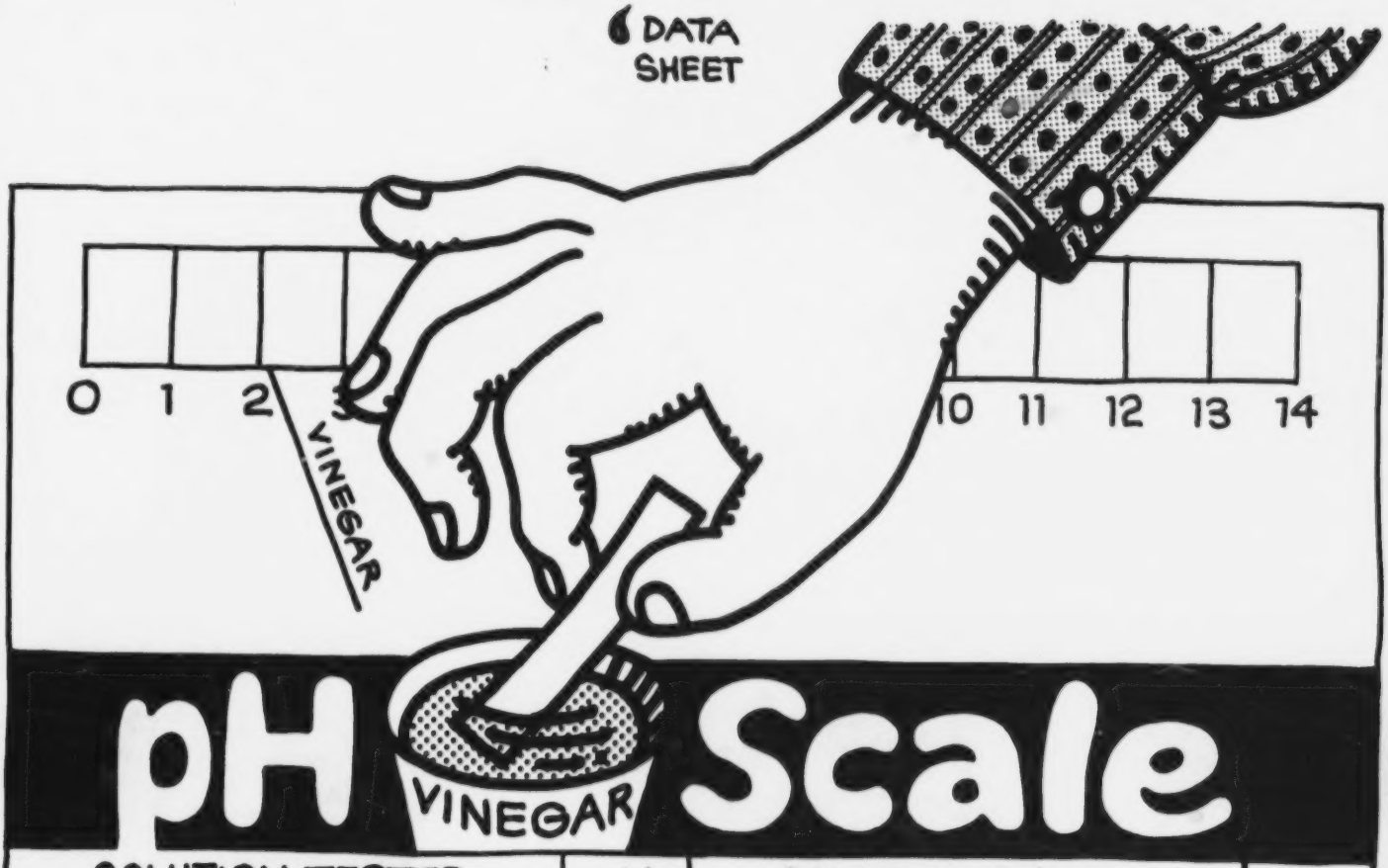
The pH Scale



BEST COPY AVAILABLE

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

DATA SHEET



pH Scale

SOLUTION TESTED	pH	SOLUTION TESTED	pH

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

DRAFT
FOR COMMENTS ONLY
NOT FOR QUOTATION
Arithmetic
Social Studies

Sources of Acid Rain

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

Time

One period of 45 minutes

Objective

Objectives:

During this activity, the students will:

1. Learn how to read a circle graph
2. Identify the major sources of acid rain

Students will use circle graphs to help them complete a worksheet about the sources of the pollutants which cause acid rain.

Class Organization

Class Organization:

Students working individually in the classroom

Materials

Materials:

Examples of circle graphs
Individual copies of worksheet
Crayon for each student

Prior to Lesson

Prior to the lesson:

Have students read the following sections of the student reader:

"Fossil Fuel", "Air Pollution", and "Superstacks".

Procedure

Procedure:

The use of circle graphs in this activity will expand on what the students have learned about sources of acid rain from the reader.

Begin by asking these questions:

1. What are fossil fuels? Where do they come from?
2. What are the elements that are released into the air when coal, gas, and oil are burned?
3. What happens to these elements in the atmosphere?

Statement: Circle graphs will help us see the different sources of nitrogen oxides and sulfur dioxides.

As a means of introduction, show several circle graphs you have found in textbooks and brochures. Explain the graphs, stressing that the whole, undivided circle represents the total, or 100%, of what is being shown.

For a more graphic explanation, draw a large circle on the board. Divide the circle into eight equal parts. Call two boys and six girls up to the board. Ask each boy to shade in one part of the circle. (They should be adjacent parts.) Discuss how 2 parts out of the total of 8 can also be written as 1/4 or 25%. Point out that the unshaded area represents the six girls. Discuss how 6 out of the 8 is 3/4 or 75%.

If further explanation is needed, draw another circle on the board. Let that one represent a dollar. Explain the various ways that the circle can be divided using quarters and half dollars.

Pass out the worksheets and crayons, explaining that the circle graphs show the different sources of nitrogen oxides and sulfur dioxides.

After the students have completed the worksheet, discuss the answers and the additional questions:

1. Transportation
   a. What do we mean by transportation?
   b. What are some kinds of transportation that we use? Which of these burn gasoline? Which don't?

2. Electrical power plants
   a. Where does our electricity come from? What fossil fuel is burned to make our electricity?
   b. Name some ways that we use electricity.
3. 32%
4. 91%
5. Turn off lights, radio, and television when I leave a room.
   Unplug iron, hairdryer, and curling iron when I'm through using them.
   Use my own energy instead of appliances such as an electric can opener, electric toothbrush, and electric mixer.
   Avoid standing with the refrigerator door open!

Extension:

Extensions

--Students can collect and display examples of circle graphs.

--Students can collect and display examples of any type of graph relating to acid rain.

--Newspaper and magazine articles relating to the sources of acid rain can be displayed in the classroom. Locate the geographic area of the news item on a world map.

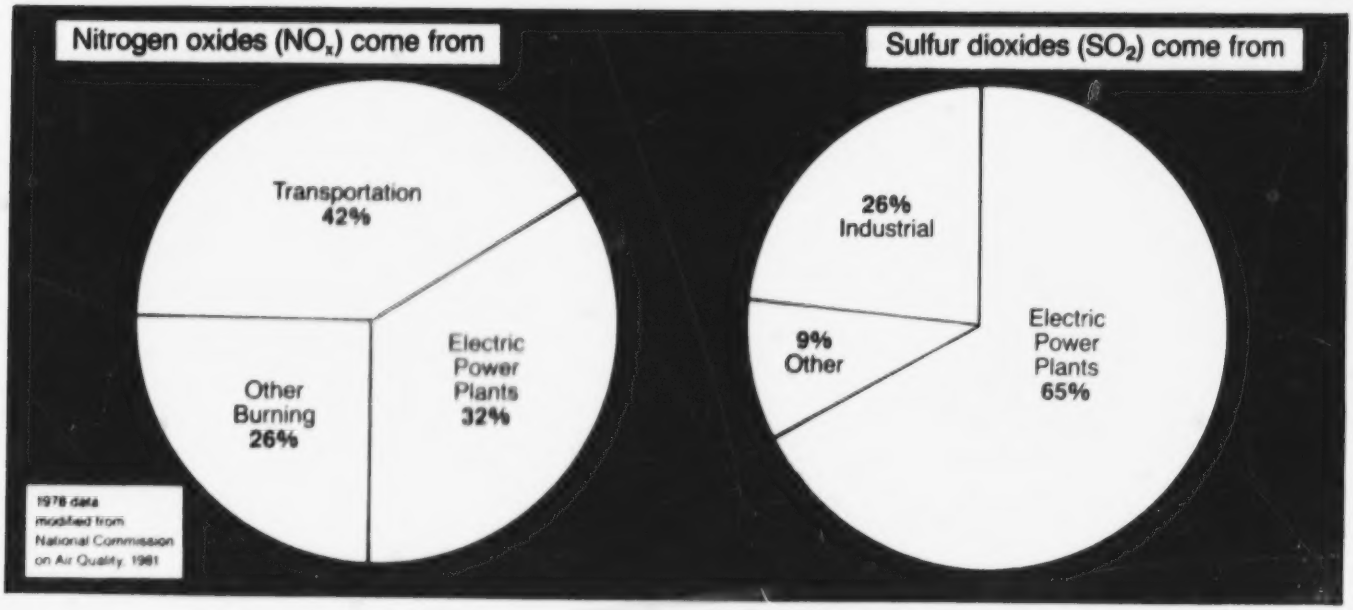
©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122

WORKSHEET

Acid Rain News

PUBLISHED IN THE BEST INTEREST OF OUR NATURAL ENVIRONMENT

SOURCES OF ACID RAIN


Nitrogen oxides (NO_x) come from
Transportation 42%
Electric Power Plants 32%
Other Burning 26%
1978 data modified from National Commission on Air Quality, 1981
Sulfur dioxides (SO_2) come from
26% Industrial
9% Other
Electric Power Plants 65%

1. Where do the greatest amounts of nitrogen oxides come from?

2. What produces the greatest amount of sulfur dioxides?

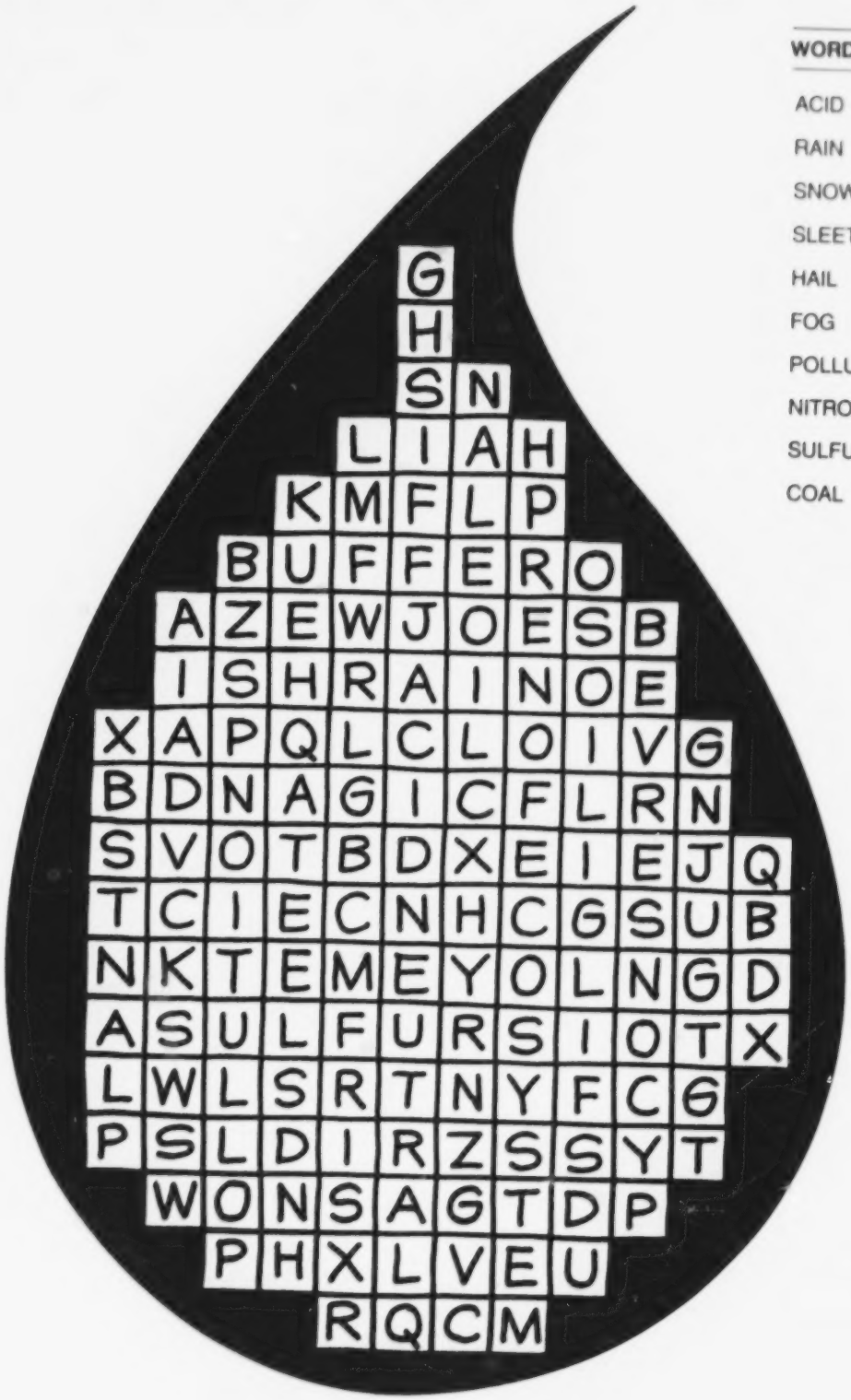
3. What percentage of nitrogen oxides comes from electric power plants?

4. What percentage of sulfur dioxides comes from electric power plants and industrial sources?

5. On the circle graphs above, lightly color the amount of NO_x and SO_x coming from electric power plants. You could help reduce these amounts by conserving electricity. Name two ways YOU could conserve electricity.

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

acid rain word find


G
H
S N
L I A H
K M F L P
B U F F E R O
A Z E W J O E S B
I S H R A I N O E
X A P Q L C L O I V G
B D N A G I C F L R N
S V O T B D X E I E J Q
T C I E C N H C G S U B
N K T E M E Y O L N G D
A S U L F U R S I O T X
L W L S R T N Y F C G
P S L D I R Z S S Y T
W O N S A G T D P
P H X L V E U
R Q C M

WORDS

ACID	OIL
RAIN	PH
SNOW	BASE
SLEET	NEUTRAL
HAIL	BUFFER
FOG	SOIL
POLLUTION	PLANTS
NITROGEN	FISH
SULFUR	ECOSYSTEM
COAL	CONSERVE

© The Acid Rain Foundation, Inc. ☐ 1630 Blackhawk Hills ☐ St. Paul, MN 55122

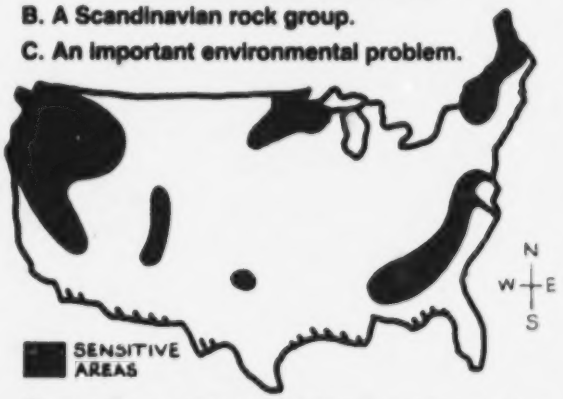
acid rain quiz for kids

1. "Acid rain" is the name given to:

A. A new shampoo that is pH balanced.

B. A Scandinavian rock group.

C. An important environmental problem.

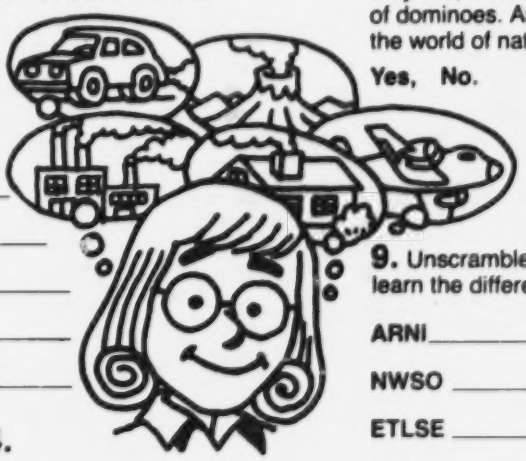


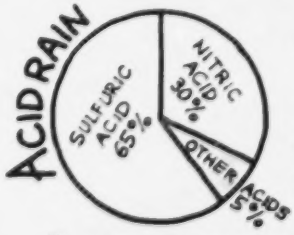
2. Two areas of the United States that seem to be especially sensitive to acid rain are:

A. Northwest B. Eastern C. South Central

3. Can you think of five major sources of air pollution?

1. _____
2. _____
3. _____
4. _____
5. _____





4.

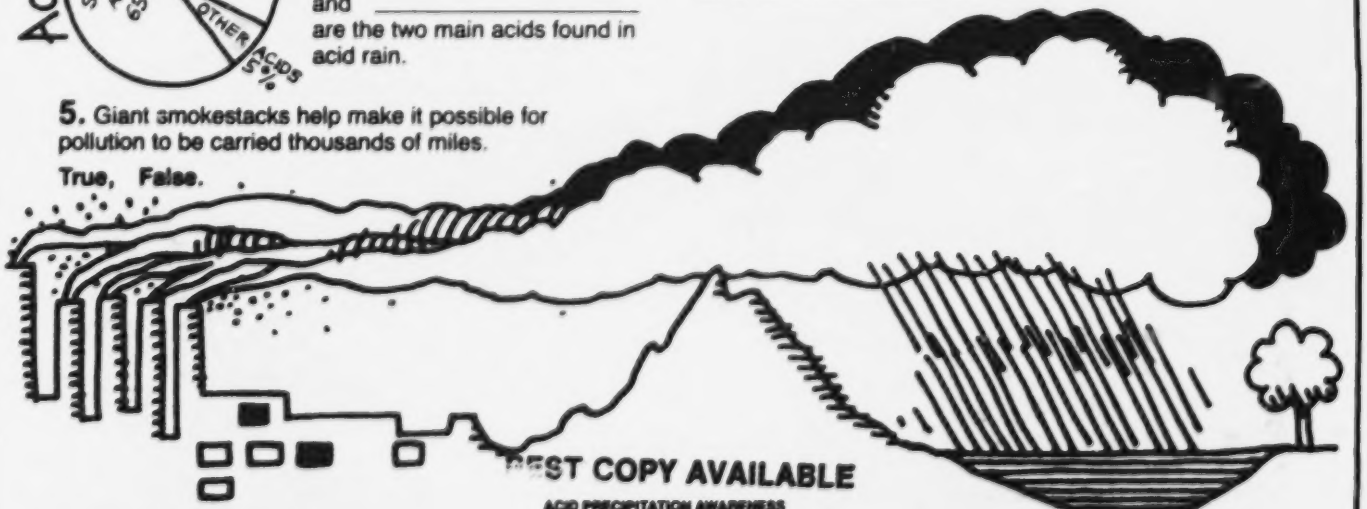
_____

and _____

are the two main acids found in acid rain.

5. Giant smokestacks help make it possible for pollution to be carried thousands of miles.

True, False.



6. Most of the energy used in the United States comes from fossil fuels such as c_____, g_____, and o_____.

7. What kind of energy is used to heat your home?

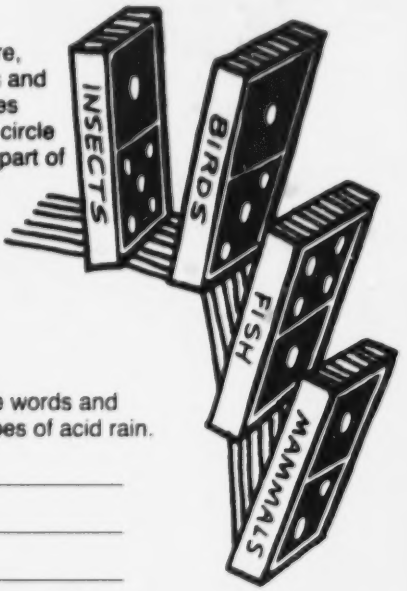
_____

Your electrical energy comes from

_____.

8. Our world of nature, which includes plants and animals and the places they live, is like a big circle of dominoes. Are we part of the world of nature?

Yes, No.



9. Unscramble these words and learn the different types of acid rain.

ARNI _____

NWSO _____

ETLSE _____

LHIA _____

GFO _____

BEST COPY AVAILABLE

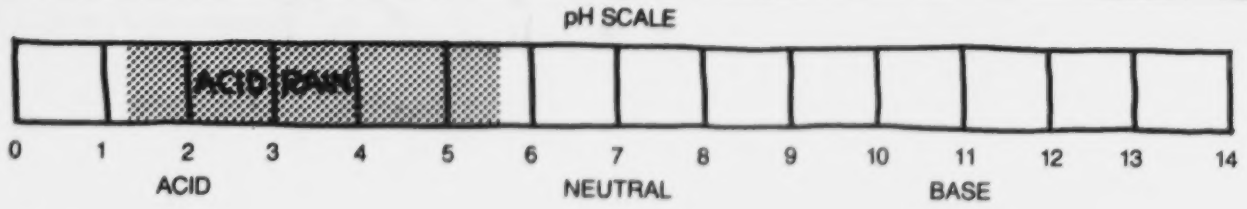
Funded by ESEA Title IV, Part C, P.L. 96-561, with the Minnesota State Dept. of Education.

ACID PRECIPITATION AWARENESS
TITLE IV-C, ESA
1037 GRIDWELL ST.
W. ST. PAUL, MN 55118

The opinions expressed herein do not necessarily reflect the views of the U.S. Department of Education.

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122 • (612) 455-7719

BEST COPY AVAILABLE



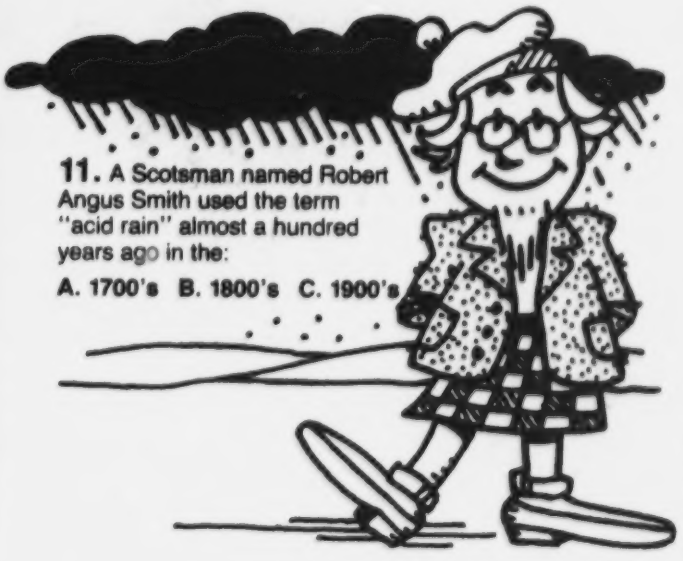
10. The _____ is the name of the numbered scale that measures the strength of an acid or base.

A solution can be called an:

_____ ,

_____ ,

or _____ .



11. A Scotsman named Robert Angus Smith used the term "acid rain" almost a hundred years ago in the:

A. 1700's B. 1800's C. 1900's

12. One way that you and I can help solve the problem is by saving energy. List some ways that you can use less energy.

1. _____

2. _____

3. _____

4. _____

5. _____

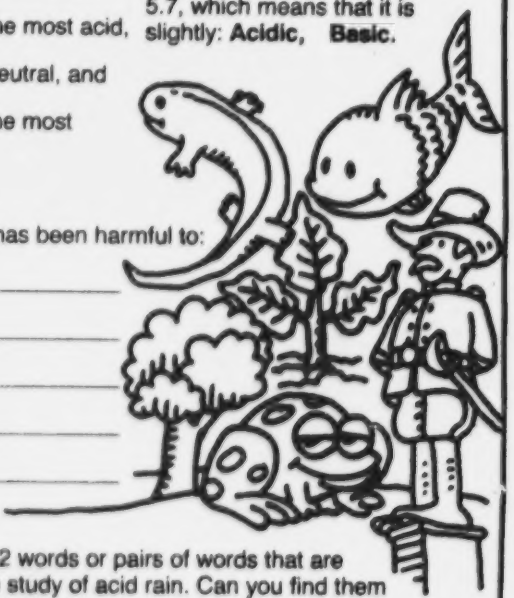
13. The lower the pH, the more acidic the solution.

pH _____ is the most acid,

pH _____ is neutral, and

pH _____ is the most basic.

The pH of normal rainfall is usually between 5.6 and 5.7, which means that it is slightly: **Acidic, Basic.**



14. Acid rain has been harmful to:

1. _____

2. _____

3. _____

4. _____

5. _____

15. Here are 12 words or pairs of words that are important in the study of acid rain. Can you find them in the word find below?

WATER CYCLE	**LIMESTONE**	**NEUTRALIZE**
ECOSYSTEM	**PRECIPITATION**	**AQUATIC**
SULFUR DIOXIDE	**NITROGEN OXIDE**	**ELEMENTS**
CONSERVATION	**DRY DEPOSITION**	**BUFFERING**

C	B	O	U	P	A	A	U	V	A	R	O	W	E	R	B	A	O	E	R
A	R	W	A	T	E	R	C	Y	C	L	E	B	A	E	T	F	L	D	L
R	O	O	M	A	N	O	T	T	O	S	O	O	N	Q	E	T	Q	B	O
T	E	P	O	J	L	I	M	E	S	T	O	N	E	U	U	E	A	O	E
T	C	L	U	B	Z	A	T	T	I	E	H	T	U	R	I	A	I	N	S
G	O	L	F	U	R	E	A	R	O	A	R	E	D	I	N	I	T	S	R
V	S	U	L	F	U	R	D	I	O	X	I	D	E	R	E	O	C	I	U
R	Y	U	P	F	L	O	R	O	R	G	K	S	T	P	U	N	N	V	C
A	S	S	U	E	D	Q	Y	O	E	V	E	D	P	N	T	W	S	E	T
M	T	E	N	R	O	A	D	I	D	A	N	N	C	A	R	A	H	N	H
D	E	N	F	I	S	H	E	P	I	L	E	T	O	R	A	R	T	I	O
O	M	V	L	N	O	O	P	O	C	O	P	Y	T	X	L	A	R	T	T
L	Q	D	A	G	A	J	O	K	K	B	C	D	X	A	I	L	L	E	Y
E	L	E	M	E	N	T	S	P	S	T	O	O	P	N	Z	D	A	N	E
A	G	R	E	F	C	F	I	V	E	V	E	N	E	I	E	I	E	I	P
P	R	E	C	I	P	I	T	A	T	I	O	N	T	U	S	K	D	A	L
O	A	V	O	Z	A	J	I	R	O	K	F	Z	I	P	C	R	O	K	I
L	P	E	R	I	E	J	O	E	D	N	U	P	A	T	O	P	O	E	E
O	I	N	O	Y	C	O	N	S	E	R	V	A	T	I	O	N	Z	L	T
O	C	T	U	Q	D	S	A	N	S	A	L	E	P	E	T	D	O	O	F

ANSWERS

1. C; 2. A,B; 3. power plants, automobiles, trucks, airplanes, home heating, industry, volcanoes; 4. sulfuric acid, nitric acid; 5. true; 6. coal, gas, oil; 7. coal, gas, fuel oil, or solar; coal, gas, oil, or running water; 8. yes; 9. rain, snow, sleet, hail, fog; 10. pH scale; acid, neutral, base; 11. 1800's; 12. turn down thermostat, turn up air conditioner, turn off lights, walk or ride a bike instead of asking for a ride, turn off appliances when you're through with them; 13. 0, 7, 14; acidic; 14. fish, salamanders, frogs, soil, plants, trees, statues.

©1985 The Acid Rain Foundation, Inc. • 1630 Blackhawk Hills • St. Paul, MN 55122 • (612) 455-7719